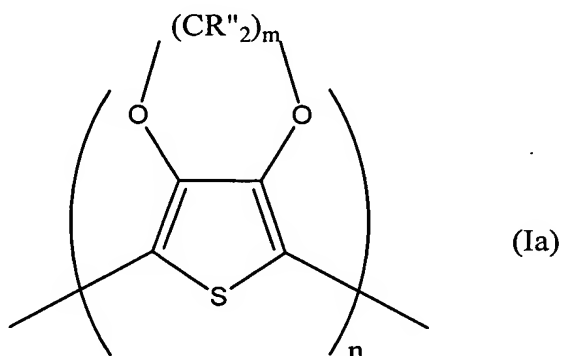


CLAIMS

What is claimed is:

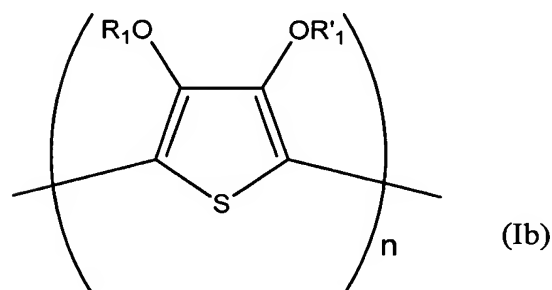
1. A composition comprising an aqueous dispersion of at least one polythiophene and at least one colloid-forming polymeric acid, wherein
- 5 said polythiophene comprises the Formula I(a) or Formula I(b):



10 wherein:

R'' is the same or different at each occurrence and is selected from hydrogen, alkyl, heteroalkyl, alkenyl, heteroalkenyl, alcohol, amidosulfonate, benzyl, carboxylate, ether, ether carboxylate, ether sulfonate, sulfonate, and urethane, with the proviso that at least one

- 15 R'' is not hydrogen,
 m is 2 or 3, and
 n is at least about 4; or



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wherein:

R'1 and R1 are independently selected from hydrogen and alkyl, or R'1 and R1 taken together form an alkylene chain having 1 to 4 carbon atoms, which may optionally be substituted by alkyl or aromatic groups having 1 to 12 carbon atoms, or a 1,2- cyclohexylene radical, and

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n is at least about 4.

2. A composition according to Claim 1, wherein said colloid-forming polymeric acid comprises a polymeric sulfonic acids, polymeric phosphoric acids, polymeric phosphonic acids, polymeric carboxylic acids, polymeric acrylic acids, and mixtures thereof.

3. A composition according to Claim 2, wherein said colloid-forming polymer acid comprises a fluorinated polymeric sulfonic acid.

4. A composition according to Claim 3, wherein said polymeric sulfonic acid is perfluorinated.

5. A composition according to Claim 1, further comprising an additional material selected at least one from polymers, colloid-forming polymeric acids, dyes, carbon nanotubes, metal nanowires, metal nanoparticles, carbon nanoparticles, carbon fibers, carbon particles, graphite fibers, graphite particles, coating aids, organic conductive inks, organic conductive pastes, inorganic conductive inks, inorganic conductive pastes, charge transport materials, semiconductive inorganic oxide nanoparticles, insulating inorganic oxide nano-particles, piezoelectric nanoparticles, pyroelectric nano-particles, ferroelectric oxide nano-particles, piezoelectric polymers, pyroelectric polymers, ferroelectric oxide polymers, photoconductive oxide nanoparticles, photoconductive oxide polymers, dispersing agents, crosslinking agents, and combinations thereof.

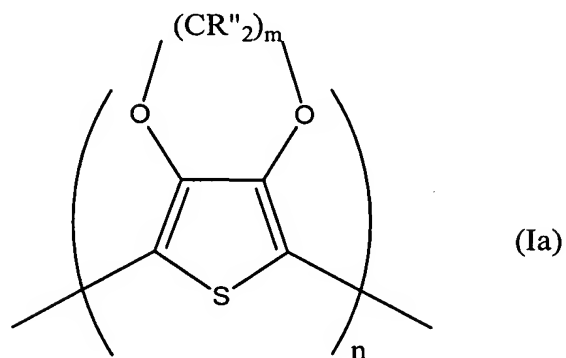
6. A composition according to Claim 1, further comprising at least one co-dispersing liquid.

7. A composition according to Claim 6, wherein the co-dispersing liquid is selected from ethers, cyclic ethers, alcohols, alcohol ethers, ketones, nitriles, sulfides, sulfoxides, amides, amines, carboxylic acids, and combinations thereof.

8. A composition according to Claim 6, wherein the co-dispersing liquid is at least one selected from n-propanol, isopropanol, methanol, butanol, 1-methoxy-2-propanol, dimethylacetamide, n-methyl pyrrozone, 1,4-dioxane, tetrahydrofuran, tetrahydropyran, 4 methyl-1,3-dioxane, 4-phenyl-1,3-dioxane, 1,3-dioxolane, 2-methyl-1,3-dioxolane, 1,3-dioxane, 2,5-dimethoxytetrahydrofuran, 2,5-dimethoxy-2,5-dihydrofuran, 1-methylpyrrolidine, 1-methyl-2-pyrrolidinone, dimethylsulfoxide, and combinations thereof.

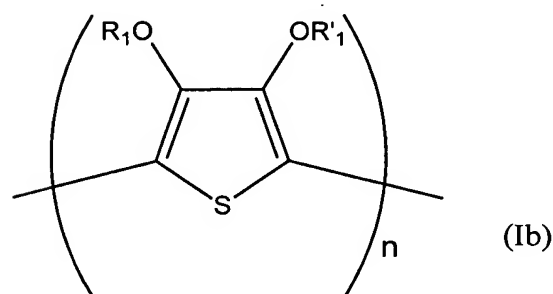
9. An electrically conductive or semiconductive layer deposited from a composition comprising an aqueous dispersion of

at least one polythiophene and at least one colloid-forming polymeric acid,
wherein said polythiophene has Formula I(a) or Formula I(b):



wherein:

R'' is the same or different at each occurrence and is selected from
hydrogen, alkyl, heteroalkyl, alkenyl, heteroalkenyl, alcohol,
amidosulfonate, benzyl, carboxylate, ether, ether carboxylate, ether
sulfonate, sulfonate, and urethane, with the proviso that at least one
R'' is not hydrogen,
m is 2 or 3, and
n is at least about 4; or

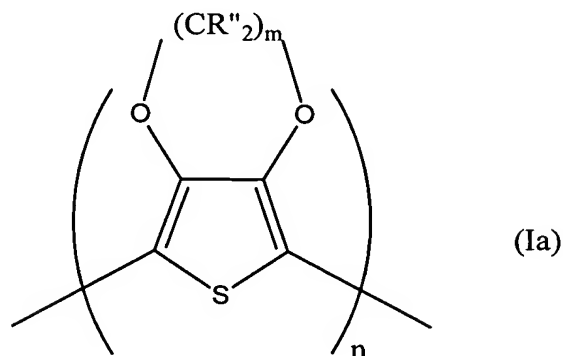


wherein:

R'1 and R1 are independently selected from hydrogen and alkyl, or
R'1 and R1 taken together form an alkylene chain having 1 to 4 carbon
atoms, which may optionally be substituted by alkyl or aromatic
groups having 1 to 12 carbon atoms, or a 1,2- cyclohexylene
radical, and
n is at least about 4.

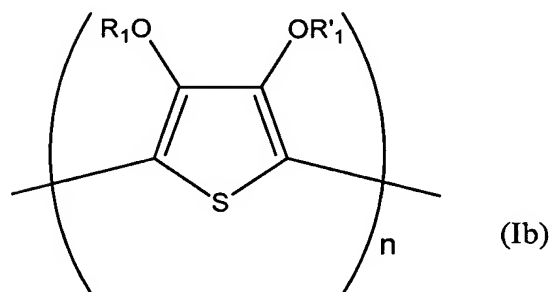
10. A buffer layer deposited from a composition comprising an
aqueous dispersion of at least one polythiophene and at least one colloid-

forming polymeric acid, wherein said polythiophene has Formula I(a) or Formula I(b):



wherein:

R'' is the same or different at each occurrence and is selected from hydrogen, alkyl, heteroalkyl, alkenyl, heteroalkenyl, alcohol, benzyl, carboxylate, ether, ether carboxylate, ether sulfonate, sulfonate, and urethane, with the proviso that at least one R'' is not hydrogen, m is 2 or 3, and n is at least about 4; or



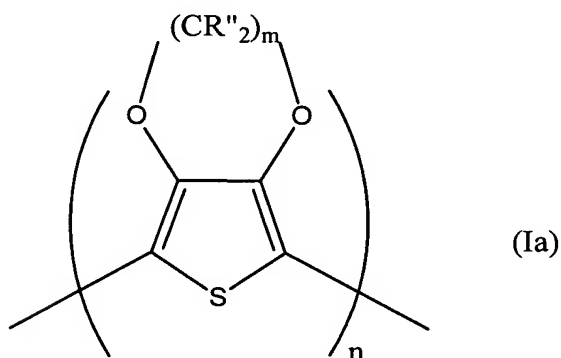
wherein:

R'_1 and R_1 are independently selected from hydrogen and alkyl, or R'_1 and R_1 taken together form an alkylene chain having 1 to 4 carbon atoms, which may optionally be substituted by alkyl or aromatic groups having 1 to 12 carbon atoms, or a 1,2-cyclohexylene radical, and n is at least about 4.

11. A buffer layer according to Claim 10, wherein the aqueous dispersion further comprises a co-dispersing liquid.

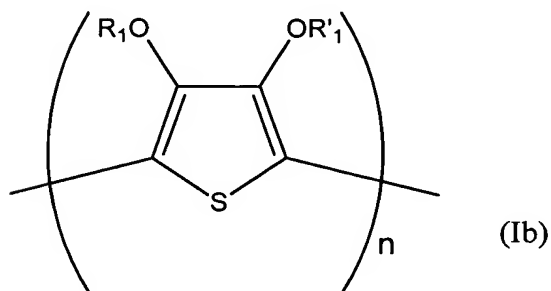
12. A buffer layer according to Claim 10, wherein the aqueous dispersion has a pH greater than 3.5.

13. An electronic device comprising at least one layer comprising a composition of at least one polythiophene and at least one colloid-forming polymeric acid, wherein said polythiophene has Formula I(a) or Formula I(b):



wherein:

- 10 R'' is the same or different at each occurrence and is selected from hydrogen, alkyl, heteroalkyl, alkenyl, heteroalkenyl, alcohol, amidosulfonate, benzyl, carboxylate, ether, ether carboxylate, ether sulfonate, sulfonate, and urethane, with the proviso that at least one R'' is not hydrogen,
- 15 m is 2 or 3, and n is at least about 4; or



wherein:

- 20 R'_1 and R_1 are independently selected from hydrogen and alkyl, or R'_1 and R_1 taken together form an alkylene chain having 1 to 4 carbon atoms, which may optionally be substituted by alkyl or aromatic groups having 1 to 12 carbon atoms, or a 1,2- cyclohexylene radical, and
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n is at least about 4.

14. A device according to Claim 13, wherein said colloid forming polymeric acid is selected from a polymer sulfonic acid, polymeric phosphoric acid, polymeric phosphonic acid, polymeric acrylic acid, polymeric carboxylic acid and mixtures thereof.

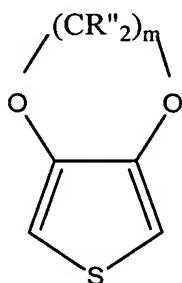
15. A device according to Claim 8, wherein said polythiophene comprises a poly[(sulfonic acid-propylene-ether-methylene-3,4-dioxyethylene)thiophene] and poly[(propyl-ether-ethylene-3,4-dioxyethylene)thiophene] and said colloid-forming acid comprises a fluorinated polymeric sulfonic acid.

16. A thin film field effect transistor comprising at least one electrode comprising the composition of Claim 1.

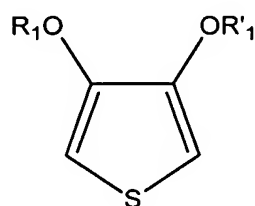
17. A thin film field effect transistor according to Claim 16 wherein said composition further comprises metal nanowires, metal nanoparticles, or carbon nanotubes, carbon nanoparticles or mixtures thereof.

18. A device according to Claim 13 wherein the device is selected from a photosensor, photoswitch, light-emitting diode, light-emitting diode display, photodetector, phototransistor, photoconductor, phototube, Infra-Red detector, diode laser, electrochromic device, electromagnetic shielding device, solid electrolyte capacitors, energy storage device, field effect resistance device, memory storage device, biosensor, photoconductive cell, photovoltaic device, solar cell, and diode.

19. A method for producing an aqueous dispersion of at least one polythiophene, said method comprising polymerizing at least one thiophene monomer in the presence of at least one colloid-forming polymeric acid, one oxidizing agent, and one catalyst, wherein said thiophene monomer has Formula II(a) or Formula II(b):



(IIa)



(IIb)

wherein:

- R" is the same or different at each occurrence and is selected from hydrogen, alkyl, heteroalkyl, alkenyl, heteroalkenyl, alcohol, amidosulfonate, benzyl, carboxylate, ether, ether carboxylate, ether sulfonate, and urethane, with the proviso that at least one R" is not hydrogen,
- m is 2 or 3;
- R'₁ and R₁ are independently selected from hydrogen and alkyl, or R'₁ and R₁ taken together form an alkylene chain having 1 to 4 carbon atoms, which may optionally be substituted alkyl or aromatic having 1 to 12 carbon atoms, or a 1,2 cyclohexylene radical.
20. A method according to Claim 19, wherein said colloid-forming polymeric acid comprises perfluoroethylenesulfonic acid.
21. A method according to Claim 19, further comprising adding at least one material selected from a co-dispersing liquid, a co-acid, or mixtures thereof.
22. A method according to Claim 19, wherein at least one thiophene monomer is added using a controlled rate of addition to a reaction mixture comprising at least one colloid-forming polymeric acid, at least one catalyst, and water.
23. A method according to Claim 22, wherein the controlled rate of addition is between about 1 to 1000 μ L of monomer per hour for each about 100 to 500 g of reaction mixture.
24. A method according to Claim 19 wherein the monomer added to the reaction mixture is added separately and simultaneously with an oxidizing agent.
25. A method according to Claim 19, wherein after polymerization the polythiophene dispersion is further contacted with at least one ion exchange resin.
26. A method according to Claim 19, wherein after polymerization a co-dispersing liquid is added.
27. A method according to Claim 26, wherein the co-dispersing liquid is selected from ethers, cyclic ethers, alcohols, alcohol ethers, ketones, nitriles, sulfides, sulfoxides, amides, amines, carboxylic acids, and combinations thereof.
28. A method according to Claim 26, wherein the co-dispersing liquid is selected from n-propanol, isopropanol, methanol, butanol, 1-methoxy-2-propanol, dimethylacetamide, n-methyl pyrrolidone, 1,4-dioxane, tetrahydrofuran, tetrahydropyran, 4-methyl-1,3-dioxane,

4-phenyl-1,3-dioxane, 1,3-dioxolane, 2-methyl-1,3-dioxolane, 1,3-dioxane, 2,5-dimethoxytetrahydrofuran, 2,5-dimethoxy-2,5-dihydrofuran, 1-methylpyrrolidine, 1-methyl-2-pyrrolidinone, dimethylsulfoxide, and combinations thereof.

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